M·A·N

MASCHINENFABRIK AUGSBURG-NÜRNBERG AG

BRIDGES

Fig. 1. **Hoangho-Bridge of the Tientsin-Pukow-Railway in China.**
Total length about 1255 metres = 4117 feet. Gerber system. Erection of the centre span (165 metres = 541 feet) simultaneously from both sides, without scaffolding. Design, substructure and erection by the M. A. N. Own part of the steel supplied about 2750 tons. Finished in 1912.

The Company supplies:

Fixed Bridges of all systems
Swing Bridges
Folding Bridges
Lift Bridges
Pontoon Bridges
Suspended Ferries

Elevated Railways
Suspended Railways
Inclined Lifts for railway cars
Charging Bridges
Traversers
Turntables; &c.

General Remarks.

The Bridge Works at Gustavsburg near Mayence in Germany, a branch of the Maschinenfabrik Augsburg-Nürnberg A.-G. (abbreviated: M. A. N.), to-day number among the largest and most productive of their kind not only in Germany, but anywhere. The construction of numerous bridges in all parts of the world, as well as the success attending the participation of the firm in many international bridge competitions form sufficient proof of this. The works at Gustavsburg took their origin from the erection of workshops required for the construction of the railway bridge crossing the Rhine above Mayence, in 1860/62, which were gradually extended so as to be capable of supplying bridges of a larger type. From 1858 to 1884 the works were directed by H. Gerber, a highly gifted designer of world-wide fame, under whose management they became exceedingly prosperous, their flourishing condition being largely contributed to by the development of the Cantilever-Bridge System, known in Germany as the „Gerber Girder". This condition continued and became still further accentuated under A. Rieppel's masterly direction, to whom we owe the design and erection of a number of highly important bridges of a bold character, as for instance the well known bridge at Müngsten, and who by successfully taking part in German and foreign bridge competitions has greatly contributed to the progress of German bridge building.

During the great war the Bridge Department of the M. A. N. has been extensively employed in replacing a large number of destroyed bridges as well as in rebuilding others by making use of constructional parts taken from the original structures, if still found serviceable, as in the cases of the railway-bridges at Namur and Kowno, the two-story bridge near Modlin, the Danube Bridge at Cernavoda and the Düna-Bridge at Riga. In some of these instances extensive clearing operations had to be carried out under very difficult conditions, as at the Borcea Bridge to the west of the Cernavoda Bridge. In addition a number of large new bridges have been erected, forming part of newly built railway lines, like the Geultal Viaduct in Belgium, the Dubissa Bridge at Lidowiany and others.

Fig. 2. **Railway Bridge over the Tjimanoek-Java.**
Preliminary erection at the Gustavsburg works.

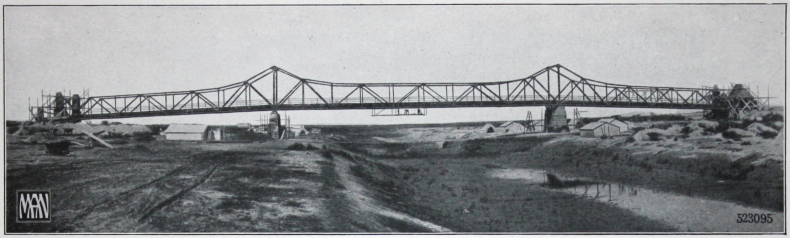

Fig. 3. **Channel Bridge No. 15, Argentine Republic.**
Spans: 44,6 + 55,8 + 44,6 metres = 146 + 183 + 146 feet.

Fig. 4. **Railway Bridge over the Rhine near Rüdesheim, Germany.**
Tied Cantilever-Arch, with parallel-girders suspended at both ends. Erected in 1914/15.

Fig. 5. **Road Bridge over the Rhine at Cologne.**

Suspension bridge with eye-bar-chain, forming a system stiff in itself. Three openings, the middle one measuring 185 metres = 606 feet. Height of pillars 31 metres = 102 feet. Chains, stiffening girders and crossgirders of the platform of one per cent nickel steel, the remaining parts of steel. Total weight of the bridge about 8200 tons. Erected in 1913/15.

Design and Workshops.

It was only by the harmonious collaboration of all people concerned with the foundation, the mechanical appliances and the architecture, the whole being directed by a trained bridge specialist, that it became possible to obtain designs coming up to the highest standard, whether looked at merely from the designer's, the economist's or the artist's point of view.

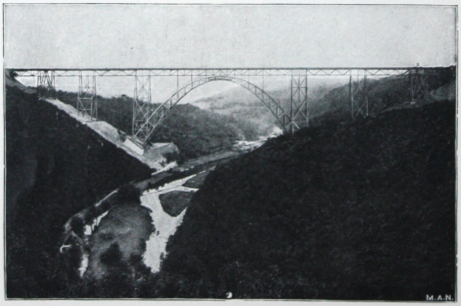

Fig. 6. **Railway Bridge over the Wupper near Müngsten, Germany.**

Braced arch without hinges. Span of arch 170 metres = 558 feet. Total length 465 metres = 1524 feet. Height of platform above bottom of valley 107 metres = 351 feet. Erected without scaffolding. Built in 1894/97.

Thus in many cases the plans made by the M. A. N. for important steel structures, among which may be mentioned those of the Elevated City Railway at Hamburg and the Suspended Railway at Barmen-Elberfeld, have been executed by other firms.

All workshops of the M. A. N., situated at Nuremberg and Gustavsburg, are provided with the latest appliances for rapid and accurate work. Above all the fact is to be mentioned that entire bridges can be put together within the works, thus ensuring a perfect fit at the final erection in situ. This is of especial importance in the case of oversea contracts.

Particular stress, moreover, is to be laid on the fact that the M. A. N., owning extensive engine works provided with the latest improvements, are enabled to work out the plans in their own offices as well as to manufacture in their own shops the whole of the mechanical apparatus required for movable (swing-, folding-, lift-&c.) bridges, which have lately come into prominence in a remarkable manner. It will be evident that these appliances can be made by the M. A. N. in a more satisfactory way than by competing firms, having no such facilities, and that the quality and consequently the working of the finished movable bridges will be improved in proportion.

Fig. 7. **Railway Bridge of the Ofot-Railway near Nordalsenden, Norway.**
Spans: 10 × 18 metres = 10 × 59,2 feet.

Erection.

For the erection in situ the M. A. N.-Works are amply provided with the latest types of machines, appliances and appurtenances of all kinds, enabling them to take the lead in initiating and developing new methods of erection. Particularly in the case of large river bridges it has become possible to dispense with the expensive scaffolding by building up the girders from both sides on the cantilever principle, thereby saving time as well as avoiding any interference with the river traffic. Another method consists in erecting entire bridge spans on any convenient piece of ground near the site and float them into position. The first method was applied by the M. A. N. as early as 1875/76 in the case of the railway bridge over the Inn at Königswart; among the many cases following this we mention that of the well known bridge at Müngsten as well as the Rhine Bridge between Ruhrort and Homberg, where the length of girder erected without scaffolding amounted to no less than 96 metres = 315 feet.

The main advantage of floating complete bridge-spans in and out and of shifting existing bridges laterally is found in the very considerable saving of time required for the

Fig. 8. **High-Level Bridge over the Argentobel (Bavarian Algäu).**

Braced viaduct on rocker-piers. The main span was erected without scaffolding. Height above mean water level 53,6 metres = 176 feet. Total length 204 metres = 669 feet. Erected in 1905/06.

procedure. In many cases a few hours only have proved sufficient, whilst entire spans have been replaced without in any way interfering with the traffic; compare the erection of the Elbe Bridge at Magdeburg.

General Contracts.

In addition to the supply of steel structures the M. A. N. take contracts for substruction work like bridge piers, either of steel, concrete or masonry, approach roads, foundations for bridge piers, &c. Especially this is the case with regard to pneumatic foundations, the first instance of which occurred in 1869, when the piers of the Inn Bridge at Simbach were built and caissoons as well as air-sluices and diving-bells were made in the M. A. N.'s own workshops. Later on these appliances were also supplied to other firms and in addition shallow foundations of a less intricate character, like those on timber-, iron-, concrete- and screw-piles were carried out in great variation. In this connection the Hoangho Bridge in China deserves a special note, as nearly all methods of foundation known at present had to be applied there.

In the following pages, tables and illustrations some examples of remarkable bridges will be found, selected from the large number of structures built by the M. A. N.

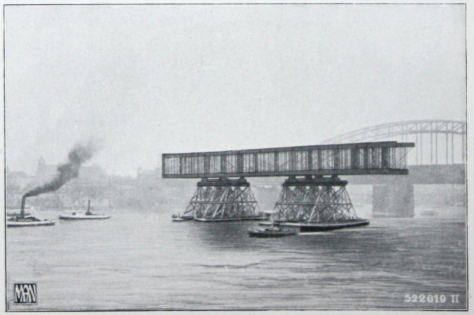

Fig. 9. **Floating Out the Old Road Bridge over the Rhine at Cologne, Germany.**

Some Examples of M. A. N. Bridges:

a) Fixed Bridges:

Situation	Description of bridge	System	Number of spans	Total length in metres	Feet	Erected in	See Fig.
Grosshesselohe	Railway bridge over the Isar	Pauli System	4	165	541	1854/57	
Mayence	Railway bridge over the Rhine	Pauli System	32	1030 (river spans 4×105)	3378 (4×344)	1861/62	
Hassfurt	Road bridge over the Main	Gerber System	3	96	315	1867	
Mannheim	Road bridge over the Neckar	Gerber System	3	188	616	1889/91	
Ruhrort-Homberg	Road bridge over the Rhine	Gerber System	5	616 (centre span 203,4)	2020 (667)	1904/07	
China	Railway bridge over the Hoangho	Gerber System	12	1255	4117	1910/12	1
Donauwörth	Road bridge over the Danube	Continuous girder with inserted side spans	5	136	446	1905/06	
Harburg	Road bridge over the Southern Elbe	Tied braced arch	4	404	1324	1898/99	
Mayence	Railway bridge over the Rhine (Kaiserbrücke)	Tied braced arch	5	542	1777	1903/04	
Cologne	Railway-and road bridge over the Rhine (Nordbrücke)	Tied braced arch	3	410	1344	1908/09	
Rüdesheim	Railway bridge over the Rhine	Tied Cantilever - Arch with parallel-girders inserted at either end	7	2 main spans 2×169,5	2×556	1914/15	4
Remagen	Railway bridge over the Rhine	Tied Cantilever - Arch with parallel-girders inserted at either end	3	Centre span 156	512	1917/18	
Lechhausen	Road bridge over the Lech	Two-hinged arch (crescent - shaped), platform on top	1	61	200	1892/93	
Worms	Road bridge over the Rhine	Two-hinged arch (crescent - shaped), platform on top	3	293	961	1897/1900	
Straubing	Road bridge over the Danube	Two-hinged arch, platform at middle height	1	91	298	1896	
Grünthal	High-level bridge over the North Sea-Baltic-Canal	Two-hinged arch, crescent shaped, platform utilised as tie	1	156	512	1891/92	
Müngsten	Railway bridge over the Wupper	Braced arch without hinges, with parallel girders inserted on treatle piers	1	Arch 170, total length 465	558 1524	1894/97	6
Passau	Road bridge over the Danube	Suspension bridge, anchored back (cable)	1	126	414	1909/10	
Cologne	Road bridge over the Rhine	Suspension bridge with eye-bar-chain, forming a system stiff in itself	3	369 (Centre span 184,4)	1211 (605)	1914/15	5
Fürth	Road bridge over the Rednitz (Maxbrücke)	Plate girder stiffened by trapezoid arch	1	37	121	1902/03	12
Bavarian Algäu	High-level bridge over the Argentobel	Braced viaduct on steel rocker - piers	4	204	669	1905/06	8
Hamburg	Bridges and viaducts of the Electric Elevated Railway	Various systems	—	—	—	1906/12	14

b) Movable Bridges and other Bridge Structures:

Mayence	Road bridge over the Zollhafen-Einfahrt	Swing bridge with equal spans	2	60	197	1886	
Ludwigshafen	Lower and middle road bridge, upper road-and railway bridge over the Rhine harbour	Swing bridges, with unequal spans	2 2 2	44,5 44,5 51	146 146 167	1894/96	
Lübeck	Road bridge over the Elbe-Trave-Canal	Double swing bridge with unequal spans	3	99	325	1901/02	
Wilhelmshaven	Road bridge over the Ems-Jade-Canal	Double swing bridge	3	150	492	1906	13
Alexandria	Road bridge over the Ibrahim Canal	Swing bridge with equal spans	2	43,5	143	1911	
Kiel	Road bridge	Single-folding bridge	1	15,5	51	1905	
Argentine Republic	Road bridge over the Rio Corrientes	Double-folding bridge	2	28	92	1907	
Norrköping	Road bridge	Double-folding bridge	2	18	59	1914	15
Görlitz	Waggon lift	Lift bridge				1913	
Osten	Suspended ferry over the Oste		1	80	262	1909	16
Barmen-Elberfeld	Suspended railway			Total length 13700	44900	1898/1903	17
Constantinople	Road bridge over the Golden Horn	Pontoon bridge, made to be swung out		470	1540	1910/12	20
Lome (Togo)	Landing stage	Plate girder of the Gerber-system (foundation on steel piles encased in concrete)		356	1168	1901/03	11

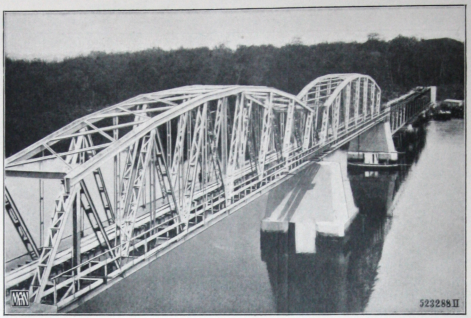

Fig. 10. **Railway Bridge over the Dibamba River (Cameroon, Africa).**
Spans: 3 × 60 + 2 × 70 metres = 3 × 197 + 2 × 229 feet. Erected 1910/11.

Among the designs, for which prizes have been awarded to the M. A. N. at bridge competitions, the following may be mentioned: Bridge over Sydney Harbour, on the Gerber system, with suspended centre span. Main span about 412 metres = 1350 feet. The foundation of the piers at a depth of about 50 metres = 165 feet was to be carried out by the freezing process. Further Pontoon Bridge over River Hoogly at Calcutta.

In their works at Augsburg, Nuremberg and Gustavsburg the M. A. N. employ about 17 000 employees and workmen. In addition to bridges they supply steel structures of different kinds, as charging bridges, cranes, traversers, turntables, inclined lifts for railway cars, &c.,

Fig. 11. **Landing Stage at Lome (Togo, Africa).**
Total length 356 metres = 1168 feet.

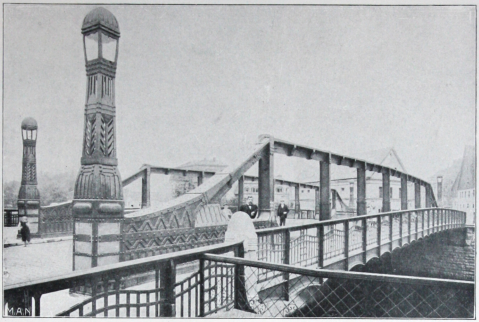

Fig. 12. **Road Bridge (Maxbrücke) at Fürth, Bavaria.**
Plate girder stiffened by trapezoid arch. Span 36,8 metres = 120 feet. Erected in 1902/03.

further all kinds of movable dams, especially roller-weirs, dock- and sluice-gates, floating docks and pontoons, ship-elevators, ship-towing appliances, as well as steel structures for all kinds of buildings in addition to power-and transport installations.

More detailed information about these points will be sent on application to all parties concerned.

Fig. 13. **Double Swing Bridge over the Ems-Jade-Canal at Wilhelmshaven, Germany.**
Spans: 39,75 + 75,50 + 39,75 metres = 130,4 + 247,7 + 130,4 feet. Erected in 1906.

Fig. 14.

Electric Elevated Railway at Hamburg.

Total weight 11 800 tons, according to the designs of the M. A. N. — Made and erected together with two other firms, 6900 tons being supplied by the M. A. N.

The illustration shows the Roedingsmarkt-Station and the adjoining curved viaduct.

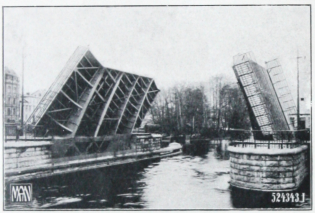

Fig. 15. **Road Bridge at Norrköping, Sweden.**

Double-Folding Bridge. Span 2×9,07 = 18,14 metres = 2×29,8 = 59,6 feet. Erected in 1914.

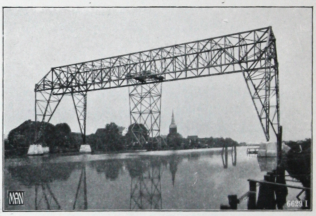

Fig. 16. **Ferry at Osten, Germany.**

Span 80 metres = 262 feet. Total weight including car 280 tons. Erected in 1909.

Fig. 17.

Suspended Railway Barmen - Elberfeld-Vohwinkel, Germany.

Length 13,7 kilometres = 8,5 miles. Monorail-Railway. The cars are suspended freely oscillating from the wheelframes. Total weight of steel structures 17 700 tons.

Designed by the M. A. N.

Made and erected together with three other important bridge works.

Built in 1898 – 1903.

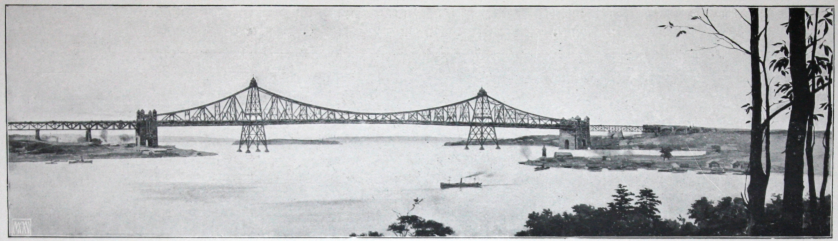

Fig. 18. **Design of Sydney Harbour Bridge** (between Sydney and North Sydney-Australia), awarded first prize at the competition in 1902.
Spans 176,8 + 411,5 + 152,4 metres = 580 + 1350 + 500 feet.

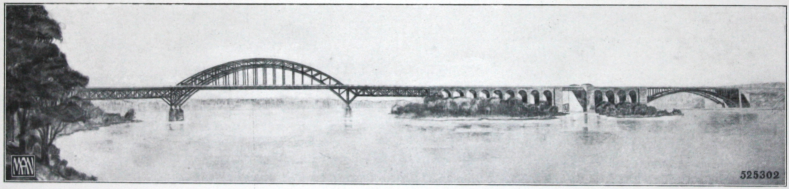

Fig. 19. **Railway Bridge crossing the Harbour District of Stockholm-Sweden.**
Design "Simplicitas", awarded first prize at the competition in 1920.

Fig. 20. **Pontoon Bridge over the Golden Horn at Constantinople.**
470 metres = 1540 feet long, 25 metres = 82 feet wide, with landing stages arranged alongside. Central part can be swung out.
Built in 1910—12.